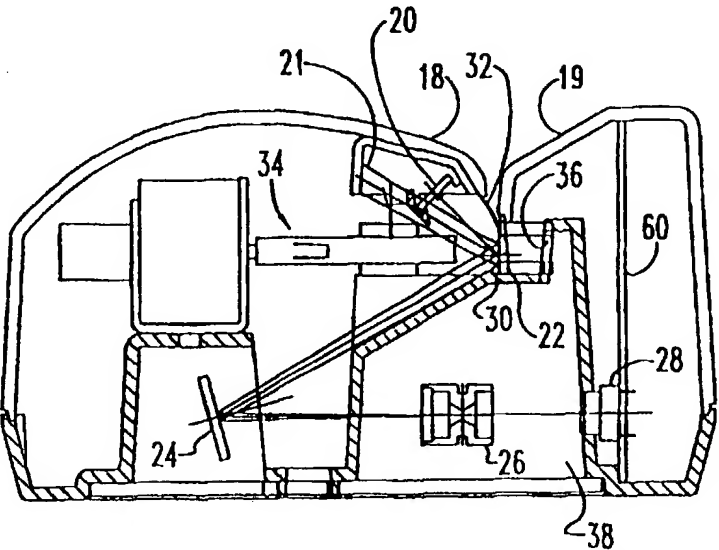




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification⁶ : G06K 7/10</p>	<p>A1</p>	<p>(11) International Publication Number: WO 97/21185 (43) International Publication Date: 12 June 1997 (12.06.97)</p>
<p>(21) International Application Number: PCT/US96/19363 (22) International Filing Date: 6 December 1996 (06.12.96) (30) Priority Data: 08/568,015 6 December 1995 (06.12.95) US (71) Applicant: COUPON TERMINALS CORPORATION [US/US]; 1 Evergreen Street, Anna, IL 62906 (US). (72) Inventors: CUNNINGHAM, William, R.; 2875 Lick Creek Road, Anna, IL 62906 (US). WANNER, Deepak; Apartment 401, 420 Parkdale, Ottawa, Ontario K1Y 1H2 (CA). (74) Agents: BAHRET, William, F. et al.; Woodard, Emhardt, Naughton, Moriarty & McNett, Bank One Center/Tower, Suite 3700, 111 Monument Circle, Indianapolis, IN 46204 (US).</p>		<p>(81) Designated States: CA, MX, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i></p>
<p>(54) Title: COUPON READER WITH STATIONARY OPTICAL SYSTEM AND COUPON</p> <p>(57) Abstract</p> <p>A coupon reader having a CCD imaging system for reading bar code on a coupon located in a fixed position in a slot in the coupon reader, and further having a punch to punch a hole through a coupon once it has been accepted. A linear array of LEDs supplies light to a bar code strip on a coupon, and light from the bar code strip is reflected by a mirror (24) to a lens (26) which is optically aligned with a CCD (28).</p> 		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgyzstan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	KZ	Kazakhstan	SG	Singapore
CH	Switzerland	LJ	Liechtenstein	SI	Slovenia
CI	Côte d'Ivoire	LK	Sri Lanka	SK	Slovakia
CM	Cameroon	LR	Liberia	SN	Senegal
CN	China	LT	Lithuania	SZ	Swaziland
CS	Czechoslovakia	LU	Luxembourg	TD	Chad
CZ	Czech Republic	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
EE	Estonia	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	UG	Uganda
FI	Finland	MN	Mongolia	US	United States of America
FR	France	MR	Mauritania	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

- 1 -

**COUPON READER WITH STATIONARY
OPTICAL SYSTEM AND COUPON**

BACKGROUND OF THE INVENTION

This invention relates to systems for redeeming coupons
5 of the type used as incentives in retail merchandising, and
more particularly to coupon readers for automatically
reading such coupons.

Coupons are well known and widely used by manufacturers
and retailers as incentives for customers to purchase
10 particular products and have gained wide acceptance among
consumers as money saving devices. Existing coupon
redemption systems are lacking in several respects, however,
despite the proliferation of coupons in the economy.

For example, although billions of coupons are redeemed
15 every year, it is still commonplace for coupons to be
manually retained, sorted and counted after being honored by
a checkout clerk. More specifically, coupons are typically
collected by the clerk in a cash register or adjacent
receptacle for later in-store processing which typically
20 includes collecting and tracking the coupons redeemed in the
store. In a large supermarket, there is likely to be a
large volume of coupons redeemed, resulting in a substantial
amount of manual, time consuming and error-prone work. The
coupons are then generally passed on to a third party,
25 referred to as a coupon clearinghouse, which processes the
coupons received from many retailers pertaining to a
multitude of manufacturers. This processing is typically
done by hand, often outside the U.S. where the required
sorting and counting work may be done more cheaply.
30 Discrepancies inevitably occur, primarily due to the
tedious, error-prone handwork, resulting in errors in
billing manufacturers and crediting retailers.

-2-

In some cases, coupons are still inspected manually by a checkout clerk, which not only wastes precious checkout line time, but also reduces the accuracy of the operation.

Examples of potential error may include overlooking an expiration date or overlooking the exact product

specification for which the coupon is valid, such as a particular package size limitation. Many stores now have their systems configured to use the same scanner to read bar code information from coupons and products alike, but such

scanners leave the coupon in its original, intact state after redemption, such that it cannot be distinguished from a coupon that has not been redeemed. This leaves open the possibility that a redeemed coupon could be mishandled and then reused inadvertently or otherwise, as well as the

possibility of fraud occurring in several ways with unused coupons. For example, particularly in larger and busier stores, register personnel may have the opportunity to slip a stack of unused coupons into the cash register and exchange them for cash. Also, a retailer can accumulate,

through any number of methods, quantities of coupons and present them to coupon clearinghouses for payment. Transaction recordkeeping systems may make such fraud

traceable, but a temptation still exists if there is no difference in appearance between used and unused coupons, as there is with systems which use the same scanner for coupons and products alike.

My prior Patent No. 5,008,519 discloses a coupon redemption system capable of automatically reading bar code on a coupon and rendering the coupon unusable after verification that the specified item was purchased, thus eliminating fraudulent redemption of coupons. This system is limited to coupons of a certain size and also requires a coupon transport mechanism within the coupon reader.

Thus, improvements are still needed in coupon redemption systems which are commercially available today in order to make them more foolproof, more versatile, and/or less complicated.

-3-

SUMMARY OF THE INVENTION

This invention provides significant improvements over the prior art by providing a coupon reader having a coupon support, a stationary light source optically aligned with an elongated portion of said coupon support, a stationary optoelectronic transducer optically aligned with the elongated portion of said coupon support and in a position to receive light from a bar code strip placed on a coupon placed in the coupon support, and a signal processor having an input coupled to the optoelectronic transducer and means for generating a digital representation of the bar code. The optoelectronic transducer of the preferred embodiment is a CCD; however, other transducers capable of generating a signal in response to light are contemplated as part of the present invention.

It is a general object of this invention to provide an improved coupon reader.

A further object is to enable reliable reading of coupon information without movement of the coupon relative to an imaging system.

Another object according to one aspect of the present invention is to provide a versatile coupon reader capable of accommodating different sizes of coupons.

These and other objects and advantages of the present invention will be apparent to those skilled in the art from the following detailed description of the preferred embodiment and accompanying drawings.

-4-

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a side view of the preferred embodiment of a coupon reader according to the present invention.

FIG. 1B is a top view of the coupon reader of FIG. 1a.

5 FIG. 2 illustrates the coupon reader of FIG. 1a with the cover and other parts removed for illustration purposes.

FIG. 3 is a sectional view of the coupon reader of FIG. 1b, with parts removed for illustration purposes.

10 FIG. 4 is a block diagram of a coupon redemption system incorporating a coupon reader according to the present invention.

FIG. 5 is a block diagram of the control circuitry for the coupon reader of FIG. 1.

15 FIGS. 6A and 6B together are a flow chart of the software implemented by the control circuitry of FIG. 5.

-5-

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

The coupon reader housing as seen in FIGS. 1a and 1b has a cover 10 and a base 12. The cover 10 has a slot 14 integrally formed therein as illustrated, the slot extending out one side of the cover to allow for entry of coupons of any width. The height of the coupon is likewise unlimited. The coupon reader so designed is adapted to receive a coupon bearing a bar code strip along its bottom edge and sufficiently close to the left edge of the coupon to be entirely within the slot when the coupon is placed therein with its left edge up against the left end stop 16 of the slot. An example of such a coupon is shown and described in U.S. Patent No. 5,008,519, which is hereby incorporated by reference. Although the bar code strip must be within the slot to be read, as indicated above, the present invention contemplates coupons of various widths and heights and is not limited to a special coupon of any particular size or shape. The cover is provided with a pair of sloped surfaces 18 and 19 to facilitate insertion of a coupon into the slot.

Referring to FIGS. 2 and 3, the coupon reader contains a stationary optical system including a light source 20, which is preferably an LED array, a coupon support or rest 22, a

-6-

mirror 24, a lens 26 and a charge-coupled device (CCD) 28, all positioned with respect to each other as illustrated in order to provide a reflective light path interconnecting the light source, the bar code strip on a coupon when in the coupon support, the mirror, the lens and the CCD. The bottom of the coupon support extends outwardly and upwardly to define a groove 30 which serves as a seat for the bottom edge of a coupon placed therein. A mylar film 32 is provided as a flexible member for firmly pressing the coupon against the wall of the coupon support. The resistance provided by the mylar film is preferably light enough to allow easy insertion of a coupon and yet sufficient to hold the coupon firmly in position and additionally press a wrinkled coupon flat so that it can be read properly. LED array 20 is preferably offset from the path 21 from which the angle of incidence of light onto the coupon would equal the angle of reflection to the mirror, in order to avoid glare, or excessive brightness of the image on the CCD.

The CCD is preferably a Sony type ILX511. A suitable lens is a Sugitoh type TS-0032T2 and a suitable LED is Stanley type HSMH-C670. The lens effectively reduces the focal length of the CCD to approximately 4 inches from approximately 10 inches without the lens. The LED array is preferably constructed with a set of such LEDs in a horizontal line of unequal spacing, with the LEDs at either end of the linear array more closely spaced than those in the center. Exemplary spacings are approximately 0.4" in the center and approximately 0.1" at either end of the array, with gradual variation of spacing in between.

A solenoid-actuated punch 34 is mounted perpendicular to the coupon support in a position to enable it to punch a hole through a coupon when energized. The punch is preferably approximately .3" in diameter. The cutout portion of the coupon is driven through an opening in the coupon support and into an inlet 36 of a receptacle 38

-7-

provided for collection of cutout portions; the receptacle is emptied as necessary via an opening in the left side of the housing (not shown).

The coupon data is preferably encoded using Code 128 subset "C" as specified by Computer Identics Corporation and available from AIM USA as Uniform Symbology Specification Code 128. The bar code preferably is printed .25" high, with at least 1/4" white space on each end of the bar code. The bar code strip is preferably in the range of 3-4 inches in length. The bar code is printed using black ink on a white background, with ink being any of the standard carbon-based inks used for the bar code. The rest of the coupon is printed using any type of ink. The paper is 40# to 50# coated.

FIG. 4 shows an overall system incorporating a coupon reader according to the present invention. The coupon reader, identified generally by reference numeral 40, is connected to an electronic cash register (ECR) 42 which is connected to an in-store central data processor 44 which is in turn connected electronically or otherwise to a coupon clearinghouse 46, as illustrated in FIG. 4. Preferably, where a local area network in a store interconnects all the ECRs and the central processor 44, the coupon reader is connected only to an ECR (and through it to the central processor). However, if desired, the coupon reader may be adapted for separate connection to an ECR and the central processor. The overall operation of the system will be appreciated from FIG. 4 to include an input from a consumer (block 48) who purchases and presents items (block 50) at the cash register including discount coupons 52, which coupons are inserted one by one into the coupon reader 40. The coupon reader scans the bar code on the coupon, decodes the coupon information, determines whether the code is valid, and, if so, sends the coupon information to the cash register.

-8-

The coupon information includes, for example, retailer identification, manufacturer's UPC number, identification of a product, coupon value, expiration date, limit of coupons per purchase, and other pertinent information. An
5 information capacity of 44 bytes of ASCII data in Code 128 format has been found to be desirable for a supermarket application. Such data may also be transmitted to the in-store data processor 44 via a multi-drop local networking transaction terminal which networks all of the ECRs of the
10 store to such central processor. Periodically, for example, once a month, pertinent stored data are supplied to the central processor of a coupon clearinghouse 46, preferably via phone link and in response to polling of central processor 44 by the coupon clearinghouse. At the
15 clearinghouse the data are sorted and arranged in a desired format for subsequent redemption by manufacturers (block 56) and for payments to retailers (block 58).

The CCD is mounted on a printed circuit board 60 along with an image processing circuit depicted in block diagram
20 form in FIG. 5. The CCD has a data output connected to a microprocessor 62, preferably a type P80C32EBAA available from Intel or Phillips, through an A/D converter 64, which is preferably a National Semiconductor type ADC0809CCV. The microprocessor also supplies command signals to the CCD via
25 a programmable logic device (PLD) 66, preferably an Altera type EPM7032LC44. The microprocessor operates under control of a stored program, which will be described in connection with FIG. 6, and has connected thereto a RAM 68, preferably a Hyundai type HY62256ALJ-10, and a flash memory 70,
30 preferably an Atmel type 29C256. The operating program is stored in the flash memory. Communications between the coupon reader and the cash register are effected via an RS232 port 72 or an RS485 port 74 which are connected to the microprocessor via a switch logic circuit 76. One of the
35 two ports is used depending on the type of cash register

-9-

with which the coupon reader is used. Another switch logic circuit 78 connects the microprocessor to the LED array and the punch.

Image processing is performed according to software depicted in the form of the flow chart of FIGS. 6A and 6B. The program starts at step 100, either by a command from the cash register or, if desired, whenever power is supplied to the coupon reader. The majority of operating time is spent in a tight loop comprising a backdrop check 102, the purpose of which is to detect the presence of a coupon in the slot of the coupon reader. A reference bar pattern with alternating black and white bars of equal width is provided on the front surface of the coupon support as a backdrop which is exposed to light from the LED array when a coupon is not in the reader and is covered by a coupon placed on the coupon support.

Each image is obtained via the CCD in a READ cycle which includes automatic exposure control, as depicted in more detail in FIG. 6B. The READ cycle begins with a step (104) of setting the exposure time of the CCD, that is, the amount of time that the CCD is enabled to respond to incoming light. The exposure time is initially a nominal value for the first READ cycle after the start of the program, and the initial value for subsequent READ cycles may be the same nominal value but is preferably based on the final value from the last complete READ cycle. The CCD is then exposed (step 105) for the set exposure time, and at the end of that time an image is captured within the CCD in the form of individual pixel values which are then converted to digital form via A/D converter 62 (step 106) and stored in RAM 70 in step 107. The total light level for the image is then compared to a reference value in step 108 to determine whether the exposure is in a desired operating range. If the image is out of range, i.e., overexposed or underexposed, the exposure time is adjusted (step 109) in

-10-

the direction needed to bring the next exposure within range. The ON time for the LED array, actuated by the microprocessor, may be set to match the exposure time of the CCD, in order to reduce power consumption or otherwise as
5 desired. Steps 104 through 109 are repeated until the exposure is in range, at which point the stored image is further processed.

In the backdrop check the stored image is then compared to the backdrop, which is also stored in the RAM. The
10 backdrop check is repeated, i.e., the CCD is repeatedly read, until a difference is detected between the current stored CCD image and the backdrop. Once such a difference is detected, the stored CCD output is decoded in accordance with Code 128 and thereby converted to a character string
15 which is then checked for validity (step 112). First the code is tested for the presence of a Code 128 start character and stop character and a Code 128 check character which properly corresponds to the data in the string. Then an arithmetic combination of values in the data string is
20 compared to an additional checksum contained in the data string. If the code is determined to be a valid code based on the above tests, the character string is sent as a coupon information message to the cash register in step 114 for processing in relation to the customer transaction, e.g.,
25 checking the coupon expiration date, checking whether the coupon item was actually purchased, crediting the customer, etc. The coupon reader waits during such processing in anticipation of a command to punch a hole in the coupon. A suitable handshaking protocol is employed to ensure
30 coordinated communication of messages between the cash register and the coupon reader.

When a punch command is received, the coupon reader, in step 116, checks to see whether the coupon is still in
35 position in the reader before it executes the punch command in step 118. This check includes a READ cycle as shown in

-11-

FIG. 6B. In the event the coupon has been removed from the reader since its bar code was read in step 102, the program branches to step 120, in which a "fail" message is generated and sent to the cash register for appropriate action, e.g.,
5 billing the customer as if no coupon had been presented for redemption. Program control returns to the start of the program in such a situation. However, in the normal situation in which the coupon is again detected in the coupon support, the punch is actuated and then the bar code
10 is read again to verify, in step 122, that less than 20% of the bar code is missing (corresponding to the cutout portion). If more than that amount is missing, the coupon is again treated as having been removed from the reader, presumably not punched, and the "fail" message is sent to
15 the cash register. If the coupon passes the test of step 122, a message to that effect is sent to the cash register (step 124), and the program returns to the start to await another coupon.

While the invention has been illustrated and described
20 in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the
25 invention are desired to be protected.

-12-

WHAT IS CLAIMED IS:

1. A coupon reader with an optical system which is stationary with respect to a coupon being read, comprising:
 - a coupon support;
 - 5 a stationary light source optically aligned with an elongated portion of said coupon support;
 - a stationary optoelectronic transducer optically aligned with said elongated portion of said coupon support and in a position to receive light from a bar code strip placed on a coupon placed in said coupon support; and
 - 10 a signal processor having an input coupled to said optoelectronic transducer and means for generating a digital representation of said bar code.
2. The coupon reader of claim 1, wherein said
15 optoelectronic transducer comprises a CCD.
3. The coupon reader of claim 2, further comprising a lens interposed between said light source and said optoelectronic transducer.
4. The coupon reader of claim 3, further comprising a
20 mirror interposed between said light source and said lens.
5. The coupon reader of claim 4, wherein said light source includes a linear array of LEDs.
6. The coupon reader of claim 5, further comprising a housing with an open side slot aligned with said coupon
25 support whereby coupons of any width can be accommodated.
7. The coupon reader of claim 6, further comprising a coupon punch fixed-mounted with respect to said coupon support.

-13-

8. The coupon reader of claim 1, further comprising a housing with an open side slot aligned with said coupon support whereby coupons of any width can be accommodated.

5 9. The coupon reader of claim 1, further comprising a coupon punch fixed-mounted with respect to said coupon support.

10. A method of reading a coupon bearing information encoded in a bar code, comprising the steps:

10 placing the coupon on a coupon support in proximity to a stationary light source;

directing light from said coupon to an optoelectronic transducer which is stationary relative to said coupon;

15 processing an image generated by said optoelectronic transducer and generating therefrom a digital representation of said bar code.

11. The method of claim 10, further comprising the step of thereafter punching a hole through the coupon to render it unusable after redemption thereof.

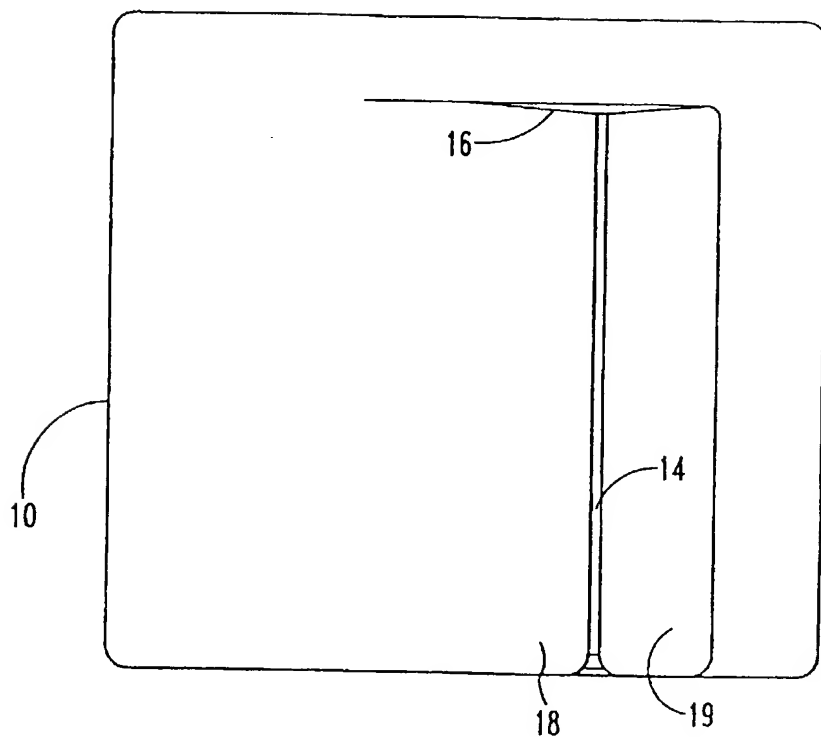


Fig. 1B

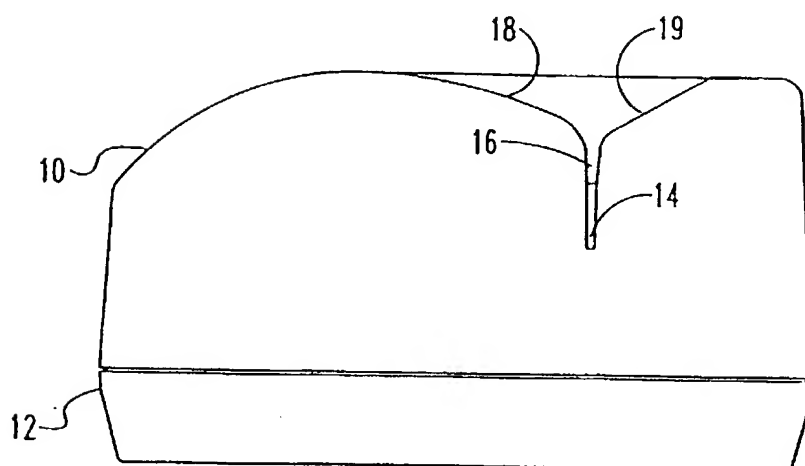


Fig. 1A

2/7

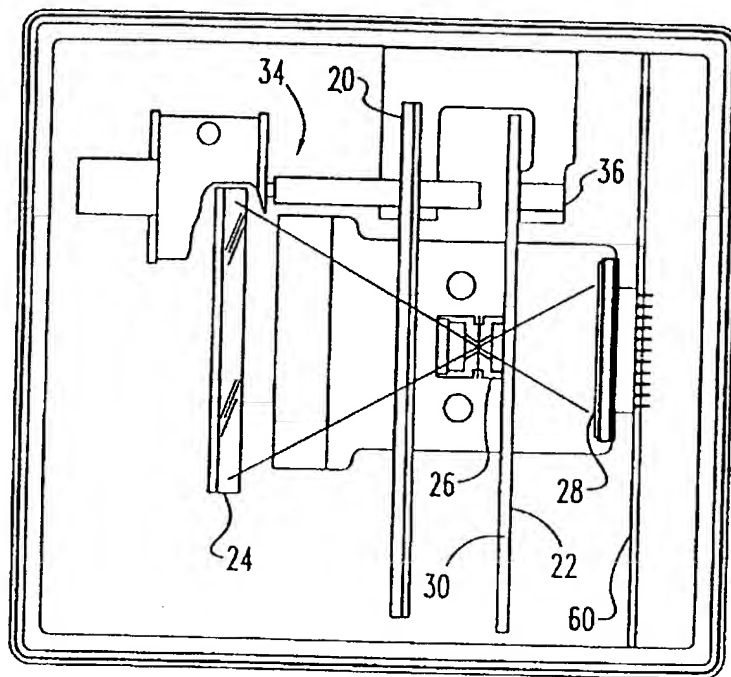


Fig. 2

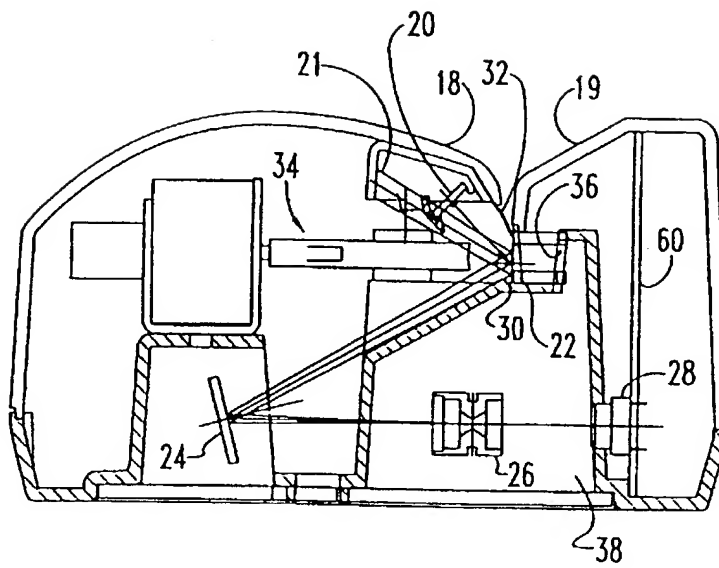


Fig. 3

4/7

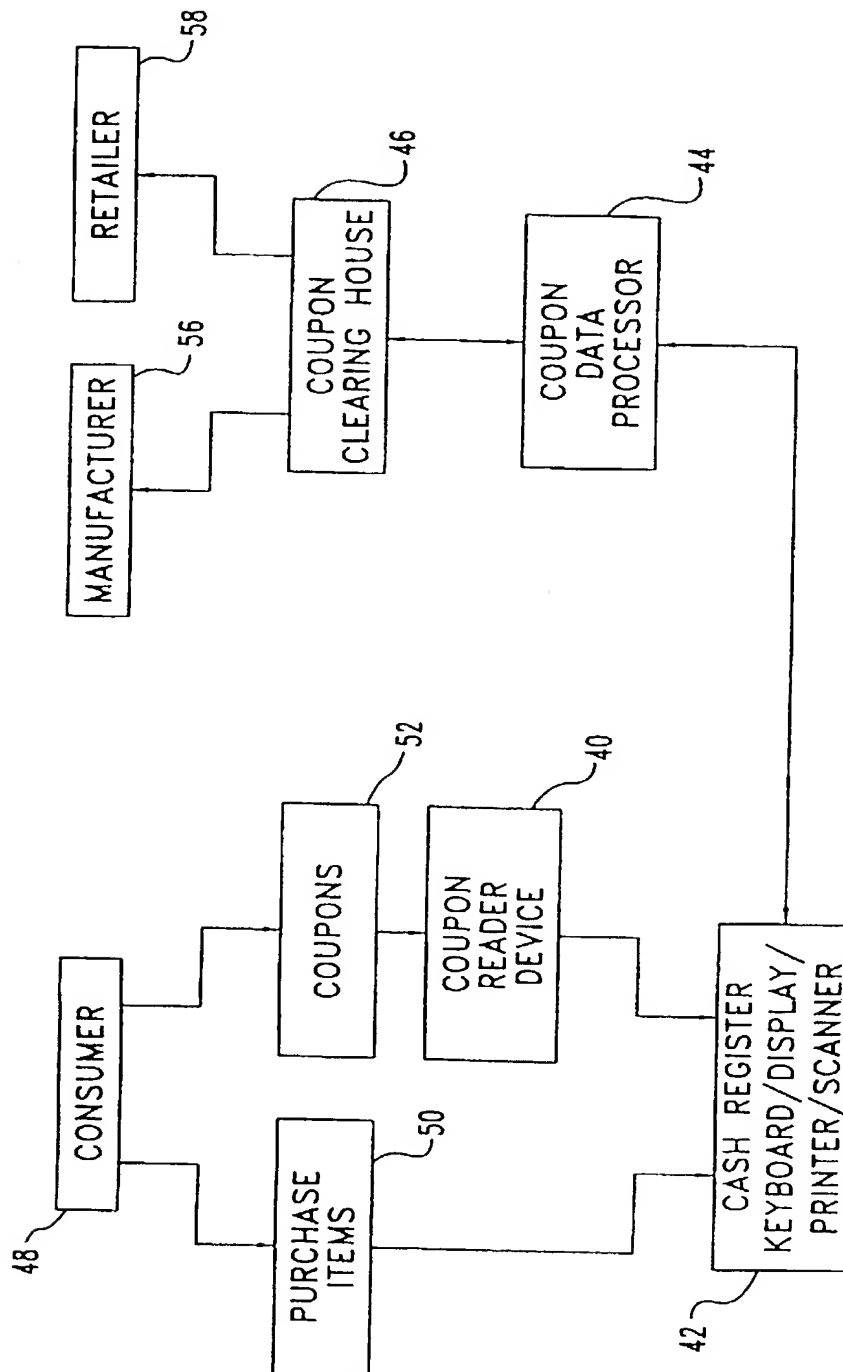


Fig. 4

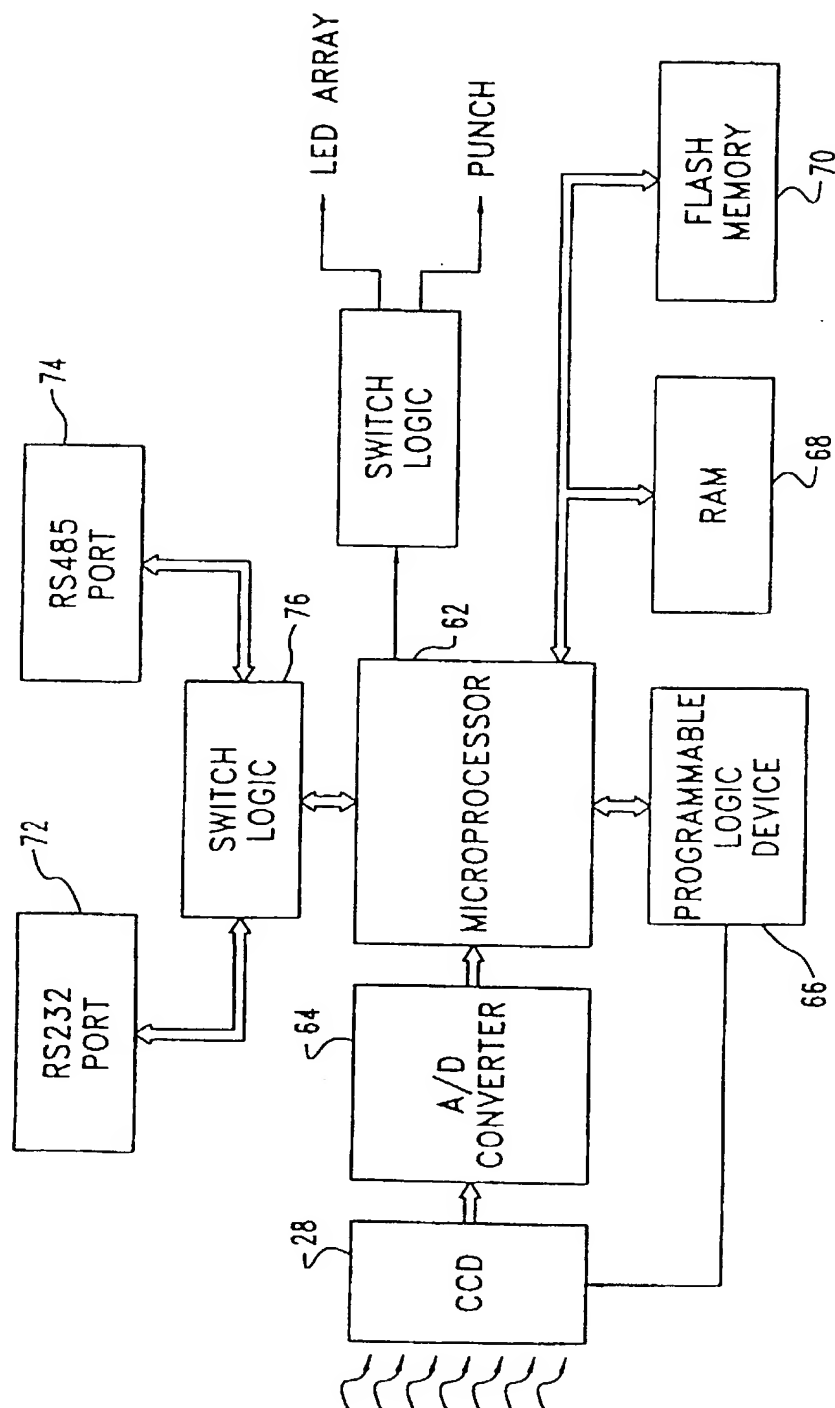


Fig. 5

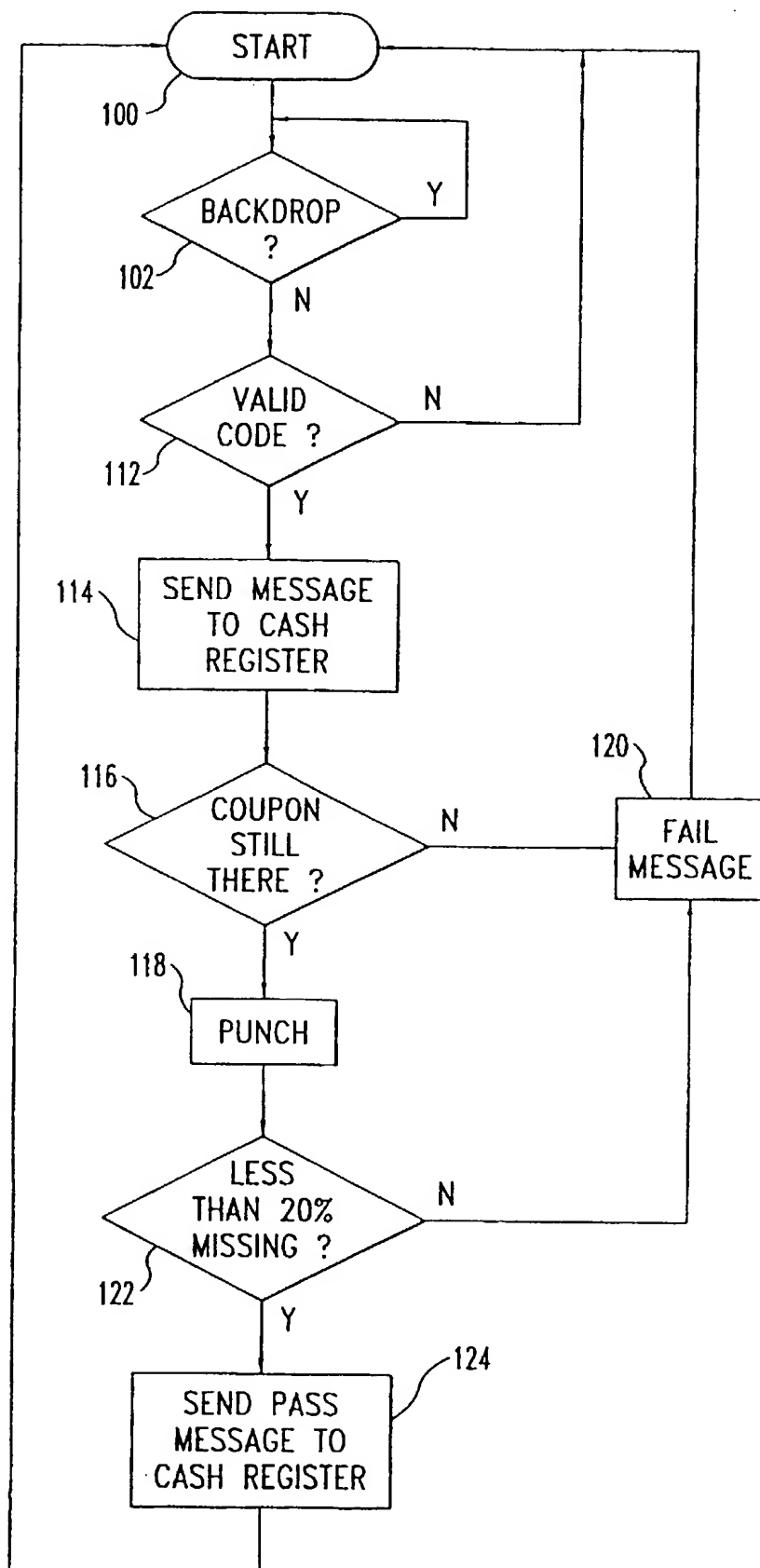


Fig. 6A

7/7

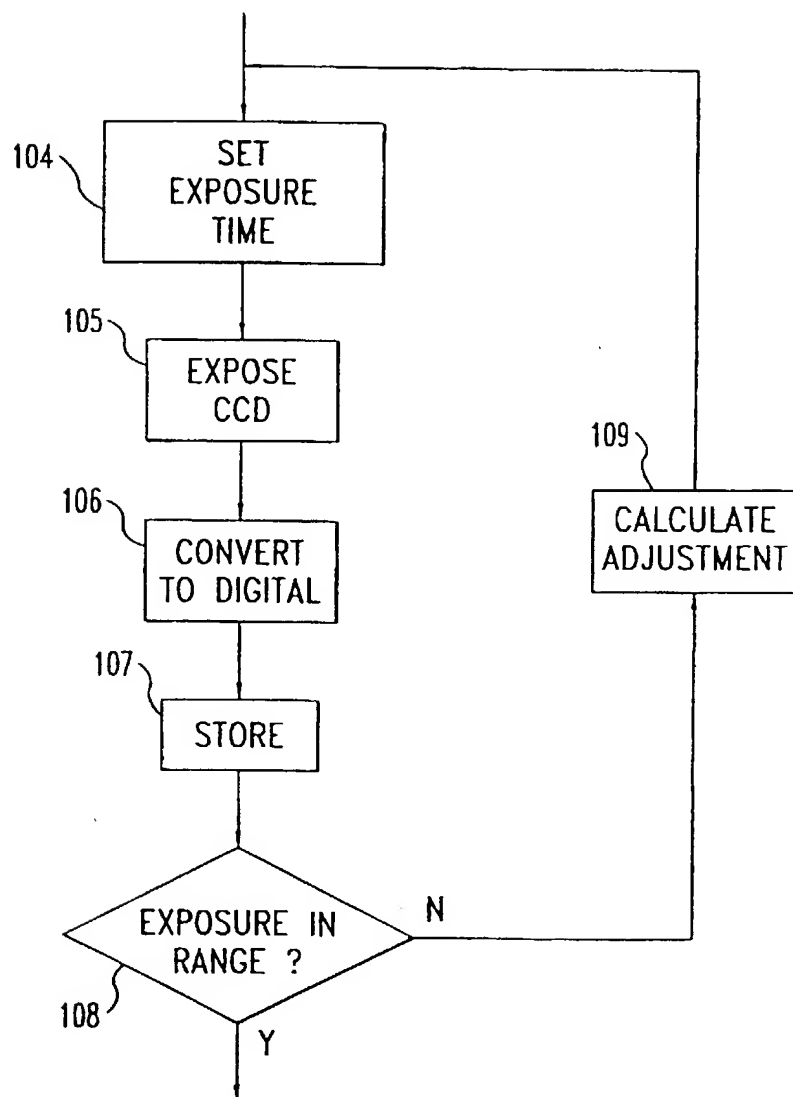


Fig. 6B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/19363

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06K 7/10

US CL :235/462

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/462, 383, 487

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, search terms: coupon reader, bar code

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,128,520 A (RANDO et al.) 07 JULY 1992, see Fig. 1.	1-11
Y	US 4,554,446 A (MURPHY et al.) 19 November 1985, see Figs. 2-5.	1-11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Z" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 20 MARCH 1997	Date of mailing of the international search report 27 MAR 1997
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer JEFFREY R. FILIPEK Telephone No. (703) 305-3505